

AMENDMENTS TO THE CLAIMS:

The following listing of claims replaces all prior listings, and all prior versions, of claims in the application.

LISTING OF CLAIMS:

1. - 24. (Cancelled).

25. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

26. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said abrasive grains are mixed in an amount of from 0.1% by weight to 5% by weight.

27. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, which further comprises a water-soluble polymer, wherein the concentration of the oxidizing agent in the polishing medium is in a range of from 0.01% by weight to 1.8% by weight.

28. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 27, wherein said water-soluble polymer is at least one selected from the group consisting of polyacrylic acid, a polyacrylic acid salt,

polymethacrylic acid, a polymethacrylic acid salt, polyamic acid, a polyamic acid salt, polyacrylamide, polyvinyl alcohol and polyvinylpyrrolidone.

29. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 27, wherein said oxidizing agent is in a concentration of from 0.01% by weight to 1.5% by weight.

30. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said acid is an organic acid.

31. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 30, wherein said acid is at least one selected from malonic acid, malic acid, tartaric acid, glycolic acid and citric acid.

32. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said protective-film-forming agent is at least one selected from benzotriazole and a derivative thereof.

33. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said oxidizing agent is at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water.

34. (Cancelled).

35. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said barrier layer is a barrier layer for preventing copper atoms from diffusing.

36. - 40. (Cancelled).

41. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said abrasive grains are made of colloidal silica or colloidal alumina.

42. – 49. (Cancelled).

50. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said medium has a pH of 2.49 to 2.95.

51. (Previously presented) As polishing condition, polishing pressure is 25 kPa and relative speed of substrate member to polishing platen is 18 m/minute, the polishing medium for chemical-mechanical polishing according to claim 62, which has:

a polishing-rate ratio (Ta/Cu) between tantalum and copper or a copper alloy of more than 1;

a polishing-rate ratio (TaN/Cu) between tantalum nitride and copper or a copper alloy of more than 1;

a polishing-rate ratio (Ta/SiO₂) between tantalum and silicon dioxide of more than 10; and

a polishing-rate ratio (TaN/SiO_2) between tantalum nitride and silicon dioxide film of more than 10.

52. – 55. (Cancelled).

56. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said oxidizing agent has a concentration of 0.15 to 3% by weight.

57. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

58. – 61. (Cancelled).

62. (Previously presented) A polishing medium for chemical-mechanical polishing, comprising:

an oxidizing agent;

a protective-film-forming agent;

abrasive grains;

an acid; and

water, wherein:

said polishing medium has a pH of 3 or less,

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight,

said polishing medium has a property of being capable of polishing a barrier layer of tantalum, a tantalum alloy or a tantalum compound, which is a barrier layer for a conductor of copper, copper alloy or copper oxide, and

said polishing medium has a property that a ratio of a polishing rate of the barrier layer of tantalum, a tantalum alloy or a tantalum compound using the polishing medium, to a polishing rate of the conductor of copper, copper alloy or copper oxide using the polishing medium, is greater than 1.

63. (Cancelled).

64. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said polishing medium includes said oxidizing agent in a concentration of from 0.01% by weight to 1.8% by weight.

65. (Previously presented) A polishing medium comprising:
an oxidizing agent;
a protective-film-forming agent;
an acid; and
water; wherein:
said polishing medium includes abrasive grains,
said polishing medium has a pH of 3 or less,
said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight,

said polishing medium has a property of being capable of chemical-mechanical polishing a surface having at least one of tantalum, a tantalum alloy and a tantalum compound, and

said polishing medium has a property that a polishing rate of said surface having at least one of tantalum, a tantalum alloy and a tantalum compound, using the polishing medium, to a polishing rate of a conductor selected from the group consisting of copper, copper alloy and copper oxide, using the polishing medium, is greater than 1.

66. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said medium has a pH of 2.49 to 2.95.

67. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

68. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

69. (Previously presented) A polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound, comprising:

an oxidizing agent for a conductor;

a protective-film-forming agent for protecting a metal surface;

an acid;
water; and
abrasive grains, wherein:
said polishing medium has a pH of 3 or less;
said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight,
said polishing medium has a property of being capable of chemical-mechanical polishing a surface having at least one of tantalum, a tantalum alloy and a tantalum compound, and
said polishing medium has a property that a polishing rate of said surface having at least one of tantalum, a tantalum alloy and a tantalum compound, using the polishing medium, to a polishing rate of a conductor selected from the group consisting of copper, copper alloy and copper oxide, using the polishing medium, is greater than 1.

70. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said medium has a pH of 2.49 to 2.95.

71. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

72. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

73. - 88. (Cancelled).

89. (Previously presented) A polishing medium for chemical-mechanical polishing, comprising:

at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

abrasive grains;

an acid; and

water, wherein:

said polishing medium has a pH of 3 or less,

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight,

said polishing medium has a property of being capable of polishing a barrier layer of tantalum, a tantalum alloy or a tantalum compound, which is a barrier layer for a conductor of copper, copper alloy or copper oxide, and

said polishing medium has a property that a ratio of a polishing rate of the barrier layer of tantalum, a tantalum alloy or a tantalum compound using the polishing medium, to a polishing rate of the conductor of copper, copper alloy or copper oxide using the polishing medium, is greater than 1.

90. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said medium has a pH of 2.49 to 2.95.

91. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

92. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

93. (Previously presented) A polishing medium comprising:
at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

an acid; and

water, wherein:

said polishing medium includes abrasive grains,

said polishing medium has a pH of 3 or less,

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight,

said polishing medium has a property of being capable of chemical-mechanical polishing a surface having at least one of tantalum, a tantalum alloy and a tantalum compound, and

said polishing medium has a property that a polishing rate of said surface having at least one of tantalum, a tantalum alloy and a tantalum compound, using the polishing medium, to a polishing rate of a conductor selected from the group

consisting of copper, copper alloy and copper oxide, using the polishing medium, is greater than 1.

94. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said medium has a pH of 2.49 to 2.95.

95. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said oxidizing agent has a concentration of 0.15% by weight to 3% by weight.

96. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said oxidizing agent has a concentration of 0.15% by weight to 1.5% by weight.

97. (Previously presented) A polishing medium comprising:
at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;
at least one selected from benzotriazole and a derivative thereof;
an acid;
water; and
abrasive grains, wherein:
said polishing medium has a pH of 3 or less;
said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight,

said polishing medium has a property of being capable of polishing a surface having at least one of tantalum, a tantalum alloy and a tantalum compound, and

said polishing medium has a property that a polishing rate of said surface having at least one of tantalum, a tantalum alloy and a tantalum compound, using the polishing medium, to a polishing rate of a conductor selected from the group consisting of copper, copper alloy and copper oxide, using the polishing medium, is greater than 1.

98. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said medium has a pH of 2.49 to 2.95.

99. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

100. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

101. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said oxidizing agent is hydrogen peroxide.

102. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said oxidizing agent is hydrogen peroxide.

103. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said surface is the surface of a barrier layer of tantalum, a tantalum alloy or a tantalum compound, said barrier layer being a barrier for the conductor of copper, copper alloy or copper oxide thereon.

104. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said oxidizing agent is hydrogen peroxide.

105. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said surface is the surface of a barrier layer of tantalum, a tantalum alloy or a tantalum compound, said barrier layer being a barrier for the conductor of copper, copper alloy or copper oxide thereon.

106. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 89, said medium including hydrogen peroxide.

107. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, said medium including hydrogen peroxide.

108. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said surface is the surface of a barrier layer of tantalum, a tantalum alloy or a tantalum compound, said barrier layer being a barrier for the conductor of copper, copper alloy or copper oxide thereon.

109. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, said medium including hydrogen peroxide.

110. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said surface is the surface of a barrier layer of tantalum, a tantalum alloy or a tantalum compound, said barrier layer being a barrier for the conductor of copper, copper alloy or copper oxide thereon.

111. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said ratio is at least 1.3.

112. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said ratio is at least 13.5.

113. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 25, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

114. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 65, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

115. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 114, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

116. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 69, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

117. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 116, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

118. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 89, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

119. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 118, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

120. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 93, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

121. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 120, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

122. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 97, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

123. (Previously presented) The polishing medium for chemical-mechanical polishing according to claim 122, wherein said abrasive grains are made of a material selected from the group consisting of colloidal silica and colloidal alumina.

124. (New) The polishing medium for chemical-mechanical polishing according to claim 62, wherein the polishing medium has the property that it polishes the barrier layer substantially without dishing of the conductor thereover.

125. (New) The polishing medium for chemical-mechanical polishing according to claim 89, wherein the polishing medium has the property that it polishes the barrier layer substantially without dishing of the conductor thereover.

126. (New) The polishing medium for chemical-mechanical polishing according to claim 62, wherein the polishing medium consists essentially of the oxidizing agent, the protective film-forming agent, abrasive grains, the acid and water.

127. (New) The polishing medium for chemical-mechanical polishing according to claim 89, consisting essentially of said at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water; said at least one selected from benzotriazole and a derivative thereof; said abrasive grains; said acid and water.

128. (New) The polishing medium for chemical-mechanical polishing according to claim 62, wherein the polishing medium consists of the oxidizing agent, the protective film-forming agent, abrasive grains, the acid and water.